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CNGI/ChinaFLUX: an IPv6-based Terrestrial Ecosystem Flux Research Network in China

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Abstract: In this manuscript, we introduce the first-step research and development on CNGI/ChinaFLUX, which is supported by CNGI (China Next Generation Internet) Project. From May 2012, we set up an IPv6-based real-time carbon flux observation system in ten sites, based on the Chinese Terrestrial Ecosystem Flux Research Network (ChinaFLUX). The hardware environment construction includes IPv6-based data transmission network platform, data acquisition system, data storage and processing system. The software environment construction includes IPv6-based observation device monitoring system, data storage and management system. Researchers develop a series of research applications in CNGI/ChinaFLUX network.

Keywords: IPv6; e-science; Terrestrial Ecosystem Flux Research Network.

1. Introduction

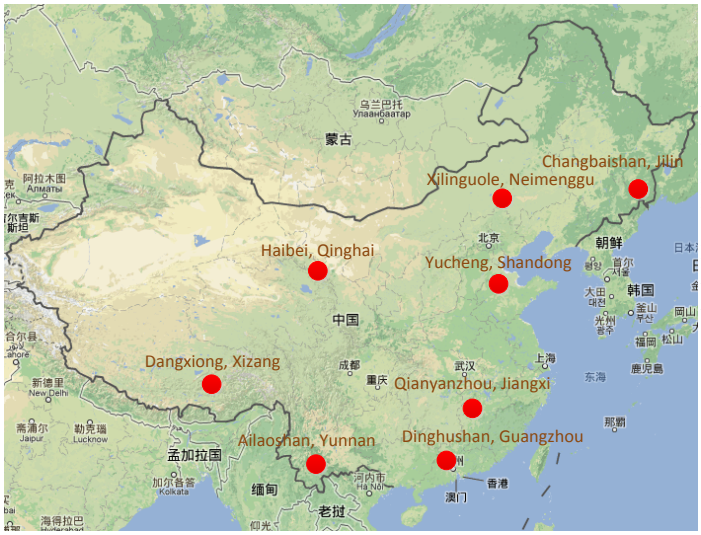
The development of next generation internet, commercial internet application, new generation information technology, and scientific research have mutually supportive relationship.

ChinaFLUX, established in 2002, is an observation and research network that provides long-term and continuous measurements of the exchange of carbon dioxide, water vapor and energy between terrestrial ecosystem and atmosphere in China [1].

In view of the e-Science's important role for scientific and technological innovation, based on the CNGI e-Science infrastructure, we started CNGI/ChinaFLUX project, focusing on information acquisition, transmission, storage, processing, and application.

2. Approach

In CNGI/ChinaFLUX project, we focus on ten sites from ChinaFLUX network, which belong to six institutes of Chinese Academy of Sciences (CAS), as is shown in Figure 1. The main work includes hardware and software environment construction.



Ecosystem Type
Changbaishan: temperate mixed forest
Xilingol: temperate steppe
Haibei: alpine meadow
Yucheng: warm temprate wheat maize cropland
Damxung: alpine steppe meadow
Naqqu: alpine steppe
Qianyanzhou: sbutropical planted coniferous forest
Dinghushan: south subtropical evergreen broadleaved forest
Ailaoshan: subtropical evergreen broadleaved forest
Xishuangbanna: tropical seasonal rainforest

Figure 1. CNGI/ChinaFLUX sites are connected to Beijing through CSTNET.

Hardware environment construction includes: IPv6-based carbon flux data transmission network platform; IPv6-based data acquisition system; IPv6-based data storage and processing system. Software environment construction includes: IPv6-based observation unit monitoring system, data storage and management system.

Three research applications are developed in CNGI/ChinaFLUX network: typical ecosystem carbon source/sinks seasonal variation and mechanism; Chinese typical regional ecosystem carbon budget distribution pattern research; Chinese terrestrial ecosystem carbon budget distribution pattern research.

3. Results of the first-step research and development

Here we introduce data transmission network platform and data acquisition system.

(1) IPv6-based data transmission network platform:

Institutes of CAS are connected to Computer Network Information Center (CNIC, located in Beijing) through CSTNET (China Science and Technology Network). All the institutes have IPv4/IPv6 dual-stack access to the internet.

Currently, seven sites are IPv6-supported: Xilinhot, Haibei, Ailaoshan, Xishuangbanna sites are connected to the institutes through fibers; Yucheng, Qianyanzhou, Dinghushan sites are connected to CNIC using IPv6 tunnels (6to4). Network of Changbaishan, Damxung, Naqu sites are under construction.

(2) IPv6-based data acquisition system:

ChinaFLUX sites have ten types of observation system: Open-Path Eddy Covariance System (OPEC), Seven Level Carbon Dioxide Profile Sampling System (CPS7), etc.

A sample site is shown in Figure 2. Figure 2 (a) shows an observation tower; Figure 2 (b) shows an observation station. We connect the serial port from data logger to TCP/IP through network serial concentrators, and set up IPv6-supported video cameras in Yucheng, Qianyanzhou, and Ailaoshan sites. Scene from video cameras are shown in Figure 3.

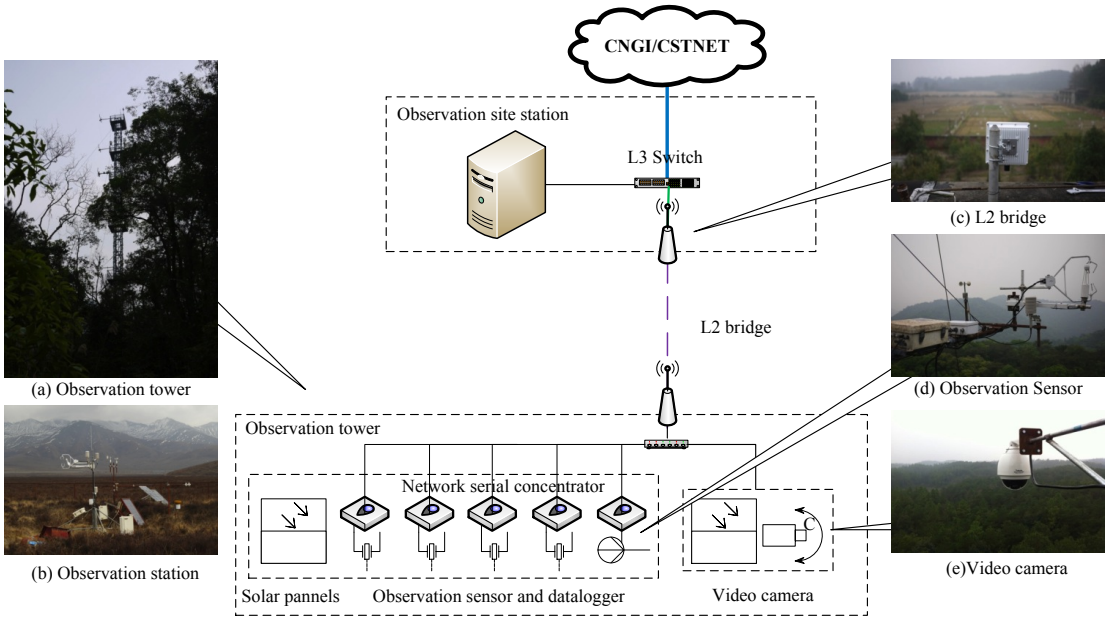


Figure 2. CNGI/ChinaFLUX site configuration.

Figure 3. CNGI/ChinaFLUX site scene from video camera.

In Yucheng site, we are also setting up two different soil moisture measurement systems for data calibration, from the view of large-scale and micro-scale: a cosmic-ray soil moisture probe system using Hydroinnova CRS/1000B, we connect the serial port to TCP/IP through concentrator; a Wireless Sensor Network (WSN) system with 13 units and 52 sensors, using IEEE 802.15.4, the system covers 700m×700m area, as is shown in Figure 4.

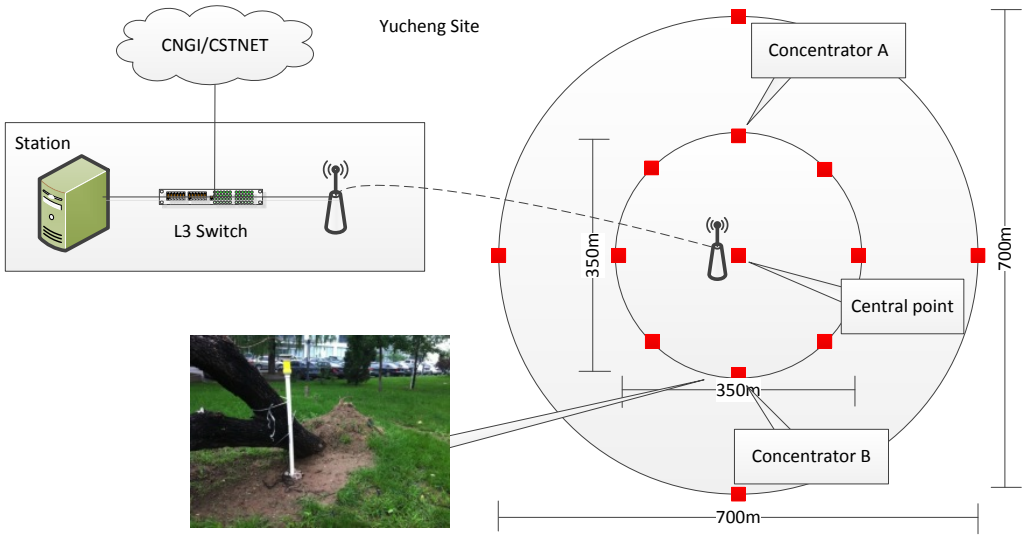


Figure 4. WSN system in Yucheng site.

4. Conclusion

This manuscript introduces the first-step research and development of CNGI/ChinaFLUX project. This work should have practical applications in at least two areas:

(1) Improving the assessment capability of terrestrial ecosystem carbon budget;

(2) Providing guidelines for the application of next generation internet technology for e-Science infrastructure.

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